UNITED STATES AIR FORCE MATERIALS TECHNOLOGY HIGHLIGHTS

Air Force Research Laboratory

Materials & Manufacturing Directorate

Wright-Patterson Air Force Base • Dayton, Ohio **Fall 1998**

Air Force Research Laboratory Opens New Coating Test Facility

A crowd filled the "C" bay of Building 22B here at Wright-Patterson AFB recently, to celebrate the inauguration and view the ribbon cutting ceremony of the Materials and Manufacturing Directorate's (ML) newest test facility, the Air Force Coatings Technology Integration Office (CTIO).

Maj. Gen. Richard Paul, Air Force Research Laboratory (AFRL) Commander, Dr. Vincent Russo, then director of ML, and Col. Robert Tipton, Coating System Program Manager, were on hand to officially cut the ribbon (a strip of paint manufactured within the facility) and dedicate the new test facility.

The CTIO facility is designed to help test and transition new coating systems from commercial manufacturers to the field, while increasing the performance and environmental compliance of current aircraft paint systems. In addition, the CTIO assists in the Air Force effort to reduce the effects of corrosion, and helps Department of Defense (DoD) customers ensure compliance with environmental guidelines, such as the 1998 National Emission Standards for Hazardous Air Pollutants (NESHAP) and Occupational, Health and Safety Administration (OSHA) rules governing worker safety at Air Logistics Centers and in the field.

The ultimate goal is to improve coating systems performance of the USAF's aging aircraft fleet, thereby reducing costs, stretching resources, and decreasing the environmental impact within the Air Force and other DoD agencies.

The showcase component of this AFRL facility is the environmentally controlled "Paint Booth." This unique and one of a kind paint booth has the capability to simulate temperature and relative humidity (RH) conditions from 40 degrees Fahrenheit to 110 degrees Fahrenheit and 10 percent RH to 90 percent RH. These parameters allow the booth to replicate "real world" painting conditions of the field units and depots. Trouble shooting coating systems applications problems will be done in the booth at the same environmental conditions experienced in the field during coating application and curing. Everything from large (6' x 6') to small (3" x 5") aircraft parts and test coupons can be painted and cured in the paint booth and then tested in other CTIO test areas within Building 22B.

A smaller CTIO coating removal technology test facility is operated at Warner-Robins Air Logistics Center, Robins AFB, GA. "These facilities will allow the CTIO to perform its mission of integrating and supporting coatings transition onto Air Force weapon systems," according to Maj. W. Kevin Kuhn, CTIO Director. The CTIO will use these new facilities to continue operating as the technical arm of the Air Force Coatings Technology Screening Committee (CTSC), the Air Force's foremost coatings consortium representing the five Air Logistics Centers (ALCs) and the Air Force Major Commands.

Dan Varga, Southwest Research Institute contractor, paints the first aircraft part in the CTIO environmentally controlled paint booth.

"CTIO test areas offer the latest in state-of-the-art coating evaluation technology," Kuhn said. "Coatings systems can be analyzed, evaluated and compared using numerous test methods to determine the systems ability to meet field conditions and environmental regulations." From application through aging—to removal, coatings systems can be taken apart via wet, dry, and general properties testing so that their behavior in the field can be accurately predicted.

Operating as a single point of contact for the ALCs and field units on paint and coating-related issues, the CTIO staff will cross-feed lessons learned to all the CTSC members, ALCs, field units and other DoD organizations to promote integrated responses in support of aircraft operations and maintenance.

For more information on the CTIO and its activities visit: http://www.ml.wpafb.af.mil/facilities/ctio/ or call (937) 255-0945.

Materials R&D Success Stories

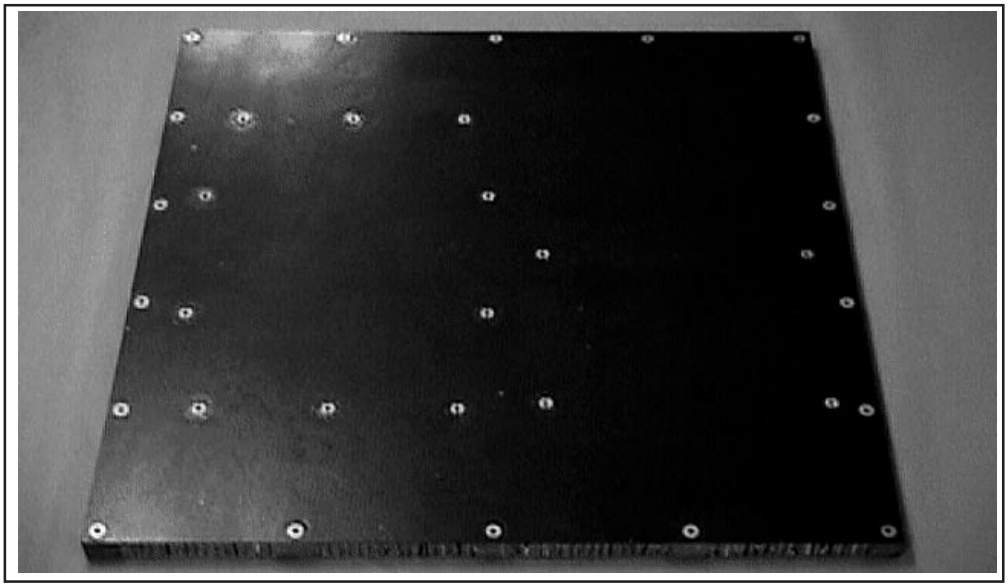
C-C Composite Radiator Panel Improves Satellite Thermal Control

A team of engineers and scientists from the Air Force Research Laboratory have designed and developed a revolutionary radiator panel that could significantly reduce thermal control costs associated with satellites and possibly extend their operational lives.

The team included people from the Materials and Manufacturing and Space Vehicle Directorates, as well as the Navy, National Aeronautics and Space Administration (NASA) and private industry. Together, they formed an informal partnership called the "Carbon-Carbon Spacecraft Radiator Partnership" (CSRP) established to promote the use of carbon-carbon materials on spacecraft.

The panel was developed to show that carbon-carbon is a cost efficient alternative for radiators on space vehicles. If successful, the new panel may dramatically change how radiators are built in the future and could lead to other important applications in space and private industry.

Satellites in orbit around the Earth dissipate tremendous amounts of waste heat from absorbed solar radiation and internal heat sources. The most common way to disperse thermal energy is through a series of special radiator panels affixed to the outside of the spacecraft.



Carbon-Carbon composite radiator panel

The current Earth Orbiter 1 spacecraft program uses passive radiators that consist of a honeycomb core with aluminum face sheets to cool the spacecraft. These panels perform well but researchers would like to enhance the thermal management capability even further by reducing the costs and weight, and possibly extending the operational life of the spacecraft.

CSRP designed and fabricated a revolutionary radiator panel that can significantly reduce thermal control costs associated with satellites and possibly extend their operational lives. CSRP replaced one of the satellite's honeycomb aluminum radiator panels, measuring about 28 by 29 inches, with an experimental carbon-carbon (C-C) panel. The new C-C panel will be used in an area where high thermal conductivity is needed to meet the thermal requirements. Flight and spare panels were built and both were subjected to flight qualification testing.

Carbon-carbon is a very special class of composite materials in which both the reinforcing fibers and matrix materials are made of pure carbon. The use of high conductivity fibers in C-C fabrication yields composite materials that have high stiffness and high thermal conductivity and, since C-C density is considerably lower than that of aluminum, significant weight savings can be realized by replacing the aluminum panels with the C-C panels. The trend for satellites is towards higher power density in combination with a reduction in spacecraft size and weight. Since C-C materials have a markedly higher specific thermal efficiency than aluminum, they offer improved performance for lower volume and mass.

Carbon-carbon composite materials enable more compact packaging of electronic devices because of their ability to effectively dissipate the heat. Also, studies have shown that entire heat pipe panels may be replaced by high conductivity C-C for some applications, thus reducing system complexity as well as integration and testing costs. In addition, since C-C is a structural material, it serves a dual purpose as both a structural and thermal management material that will eventually eliminate the requirement for thermal doubler plates, which typically add substantial mass to a spacecraft. Finally, since C-C is a composite, its structural and thermal properties are tailorable, adding capability and flexibility to spacecraft designs. The new radiator panel is one of eight technologies that will be demonstrated on the Earth Orbiter 1, to be launched in 1999,

For more information, contact the Materials and Manufacturing Directorate's Technology Information Center at techinfo@ml.wpafb.af.mil or (937) 255-6469. Refer to item 98-157.

CALENDAR OF EVENTS

Materials Solutions Exposition (ASM)
October 12-15, Rosemont, IL

DoD Maintenance Conference
October 18-21, Fort Worth, TX

MIL-HDBK-5 Meeting for
Metallic Materials and Elements
for Aerospace Vehicle Structures
October 19-22, Chicago, IL

1998 National Space and Missile
Materials Symposium
October 19-22, Colorado Springs, CO

Air Force Pollution Prevention IPT
November 3-5,
Panama City Beach, FL

C-17 Pollution Prevention IPT
November 3-5,
Panama City Beach, FL

Defense Manufacturing Conference
November 30-December 3,
New Orleans, LA

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Treatment System Eliminates Harmful Chemicals From Wastewater

A wastewater treatment system that can eliminate harmful ammonium perchlorate generated by the high-pressure washout of rocket propellants has been developed by scientists at the Air Force Research Laboratory Materials and Manufacturing Directorate.

The new system uses micro-organisms to breakdown the ammonium perchlorate into chloride. Upon full-scale implementation of this revolutionary system, up to 5,000 gallons per day of contaminated wastewater may be treated.

Nearly every major weapon system which has solid propulsion, explosive or pyrotechnic devices contains perchlorate compounds. Ammonium perchlorate (AP) is an oxidizer and a primary ingredient in solid propellant for most large rocket motors. The Minuteman III Propulsion Replacement Program (PRP) will remove more than 35 million pounds of propellant from 1,200 first and second stage motors in order to recover and reuse the valuable motor cases. High-pressure water washout is the accepted process to remove propellant for component or ingredient recovery, remanufacture or demilitarization. The process produces large quantities of water contaminated with AP which must be treated as a hazardous waste.

Bioreactor system used to degrade ammonium perchlorate

With the discovery of a strain of bacterium which is capable of degrading perchlorate to harmless chloride, a bench-scale process was optimized into a pilot-scale system to treat up to 4,000 gallons per day of AP wastewater. This wastewater was produced by the recovery process designed to crystallize AP for reuse and return washout water back to the high-pressure system. The bioreactor system reduced perchlorate concentrations from 6,000 ppm (parts per million) to below detectable limits, at a cost of less than 20 cents per gallon.

For more information, contact the Materials and Manufacturing Directorate's Technology Information Center at techinfo@ml.wpafb.af.mil or (937) 255-6469. Refer to item 97-171.

Personal Laser Dosimeter Badge May Provide Near Real-Time Detection and Monitoring of Laser Radiation Exposure

Scientists at the Air Force Research Laboratory Materials and Manufacturing Directorate have patented a personal dosimeter badge for recording exposure to laser radiation.

The small, inexpensive, disposable badge could, for the first time, provide the ability to detect laser radiation, determine its wavelength and record dosages received on a person-by-person basis. Providing a near real-time recording device for intentional or unintentional laser radiation exposure may help further protect military personnel on modern battlefields and also enhance exposure control for anyone working in laser operations environments.

Military personnel on modern battlefields and persons working in laser operations environments such as test ranges and research laboratories are sometimes exposed to laser irradiation, either intentionally or unintentionally. Having the ability to almost immediately detect on a person-by-person basis the presence of laser radiation and dosage level received could provide enhanced exposure control and protection for personnel operating in these environments. To date, such laser detectors and dosimeters have existed only in extremely bulky forms that generally take up the space required for a full-scale optical bench which can be up to 10 meters across.

Directorate scientists are developing a dosimeter badge about the size of a postage stamp, and approximately one-eighth inch thick, which provides a quick, highly reliable way of determining whether or not an individual has been exposed to laser radiation. The badge also provides a method for determining, from the recording, the wavelength of the laser irradiation and the energy dosage received. Two other advantages of the new device are that it is inexpensive and the materials involved in the process are disposable.

The dosimeter badge is comprised of a low-profile prism or Fresnel biprism placed in optical contact with photopolymerizable material that splits an incident laser beam into two beams and causes them to cross. When they cross, the result is an interference pattern, or hologram, in the photopolymerizable material which is recorded in near real time. One of the most important characteristics of the badge is that only coherent light, such as light from a laser, will produce the interference pattern. Other types of light, namely incoherent light, regardless of how bright they are, are unable to produce an interference pattern and therefore are not recorded. Once the laser light is recorded, it can be analyzed later to determine its wavelength and energy dosage. The recording process, which takes place in one step, can be read using conventional optical equipment and techniques and requires no further development or processing. The materials used for the badge are currently undergoing further development and characterization.

For more information, contact the Materials and Manufacturing Directorate's Technology Information Center at techinfo@ml.wpafb.af.mil or (937) 255-6469. Refer to item 98-033.

NEW CONTRACTS

- Development Of Laser Fusion Coatings For Improving Oxidation Resistance Of Carbon-Carbon Composites - F33615-98-C-5052
- Polyarylene Ether (Pae) Based, High Performance, Solvent Free Processing Of Aircraft Canopies - F33615-98-C-5053
- Processing Of High Tg Polymers For Aircraft Canopies Using A Supermicrocellular Foaming Technique - F33615-98-C-5054
- Structural Repair Of Aging Aircraft - F33615-98-2-5113
- Rapid Laser Shock Peening - F33615-98-C-5116
- Metal Forming Simulation For Stretch-Forming Process - F33615-98-C-5120
- Laminated Object Manufacturing Based-Design For Ceramic Matrix Composites - F33615-98-C-5121
- Advanced Manufacturing And Modeling Simulation (AMMS) - F33615-98-D-5128
- Parts Obsolescence Management Tools - F33615-98-C-5129
- Weapon System-Integration Cost Model (WS-ICM) Detail Design - F33615-98-C-5137
- Manufacturing Technology For Affordable Laser Shock Peening - F33615-98-C-5150
- Hybrid Preform Manufacturing For Automated Fabrication Of Integrally Stiffened Structures - F33615-98-C-5153
- Computer Enhanced Eddy Current Detection Of Hidden Substructure Edges And Holes - F33615-98-C-5154
- Breathable Release Coatings For Ceramic Tooling - F33615-98-C-5159
- Reproducible F119 Turbine Exhaust Case (TEC) Castings - F33615-98-C-5160
- Simulation-Based Design System For Multi-Stage Manufacturing Processes - F33615-98-C-5161
- Enhanced Laser Generated Ultrasound - I - F33615-98-C-5200
- Life Prediction Methodologies For Aerospace Materials - F33615-98-C-5214
- Mixed Anion Heterostructure Materials - F33615-98-C-5428
- Yttrium barium copper oxide (YBCO) Superconductor Deposited On Ceramic Ferrite - F33615-98-C-5436
- New Family Of Optical Materials For Hi-Power Optical Frequency Conversion - F33615-98-C-5437
- Biofilter Processes For Treatment Of Combined Paint Stripping and Paint - F33615-98-C-5854

Not the Last Issue of Materials Technology Highlights

In a previous issue of this publication, it was announced that the Materials Technology Highlights and the Manufacturing Technology Program Status Report would be combined. This was in error. The two will continue to be printed as separate publications.

The USAF Materials Technology Highlights is published quarterly to provide information on materials research and development activities by Air Force Research Laboratory's Materials & Manufacturing Directorate. For more information on subjects covered in "Highlights" or to be added to the "Highlights" mailing list, contact the Materials & Manufacturing Directorate Technology Information Center at (937) 255-6469 or e-mail at techinfo@ml.wpafb.af.mil. Approved for Public Release (ASC/PA#98-2190).

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